No. 28.

THE Sidereal Messenger.

Conducted by Wm. W. PAYNE,
Director of Carleton College Observatory.

OCTOBER, 1884.

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"He telleth the number of the stars; He calleth them all by their names."

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DIFFRACTION GRATINGS.

Professor Rowland of the Johns Hopkins University has placed in my hands the distribution of the fine gratings ruled on his engine. The plates are ruled with 14,438 lines to the inch. Five sizes are ruled, viz. 1 inch 1½ in, 2 in, 3 in, and 5 in. For full information address, J. A. BRASHEAR, PITTSBURG, S. S. PENNA.

The Sidereal Messenger.

Conducted by Wm. W. PAYNE, Director of Carleton College Observatory, Northfield, Minn.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

VOL. 3. NO. 8. OCTOBER, 1884. WHOLE NO. 28.

Translation of part of a paper by Dr. A. Steinheil on the Errors and Adjustments of Oject-Glasses of two Lenses, by Miss. Emma Gattiker.

In Dr. STEINHEIL's paper, (A. N. 2606), he first gives the five conditions which objectives of two lenses can and must fulfill; and after an interesting general analysis of the whole problem, he proceeds to give certain practical processes which enable anyone to examine an objective for himself. The whole paper should be read in the original. The following translation of the practical part can not fail to be of interest.

"Different tests, corresponding to the nature of the errors, are to be applied according as the errors affect the point on the axis at which the image is formed, or the entire image extending beyond the axis.

In considering those errors which affect the point on the axis at which the image is formed, it is best probably to study the image formed by a single luminous point.

Let the telescope be pointed at a luminous point, say the image of the *Sun* on a polished ball of black glass of small diameter, and observe what is the disposition of the light in the discs into which this image is resolved by moving the

eye-piece in the direction of the optical axis toward or away from the objective, before placing it at the image formed on the axis, so that using the eye-piece as a magnifying glass, the cross sections of the cone of light may be examined on each side of the plane of the image.

Before I attempt to describe how the various errors manifest themselves, it is necessary to notice that the eye of the observer must first be examined, because the errors in it make themselves apparent in the appearance of the discs of light into which the image appears to be resolved in the planes on either side of the plane of the image.

For this purpose let the farthest point of distinct vision be fixed at 6–8 in. (16–22 centimetres) by means of a good lens, unless the eye be naturally near-sighted. Place the glass ball with the picture or image of the *Sun* on it at this point, then fixing the eye on the image, move the glass ball toward and from the eye.

If the ball be moved beyond the point fixed as the farthest point of vision, the image will be immediately resolved, if, however, the ball be brought toward the eye, the image can be preserved until its proximity is so great that it can no longer be overcome by the accommodation of the eye. If it be brought still nearer, the image will break up into discs as before.

The limits within which the image can be preserved intact depend upon the power of accommodation of the eye, which again depends largely upon the age of the observer.

Care must be taken in making the observations, that the line of sight toward the artificial star fall upon the axis of the lens.

If the eye be perfect, the image will be resolved into similar, circular, brightly illuminated discs, on being moved in either direction beyond these limits; while if the eye be imperfect, the form or illumination of these discs will be affected.

In case of regular astigmatism, the discs are oval, not round, and the direction of the long and short axes changes in passing through the plane of the image, for instance passing in, the long axis may be vertical, passing out the short

one. If the eye contain imperfectly transparent places, the illumination will be less at certain points, etc.

If it be necessary to observe with an imperfect eye, its errors must be taken into account in testing the objective. A good eye will, when the eye-piece is moved as above described, in or out from the plane of the image, see the image resolved into round equally illuminated discs. If we examine the influence of the various errors which affect the focus we shall have of the errors occurring in the construction of the objective, the chromatic and spherical aberrations.

We call an error uncompensated when it is of the same sort as that of a single positive lens.

We shall find when the chromatic aberration is not compensated, that is, when the more highly refrangible rays have too short a focal distance, that the disc will be red toward the edge when the eye-piece is moved in, while on moving it out it is bordered by red (if the error is small, by orange), if the error of color is over-compensated, that is, when the more highly refracted rays have too long a focal distance,—the converse.

If the rays entering near the edge of the objective have a shorter vocal distance than those of the same color entering near the axis, the spherical aberration has not been compensated, and the disc will be sharply defined on the edges on pushing in the eye-piece, while on drawing it out it will have an ill-defined radiating edge.

The light per area is much less near the edges.

If the spherical aberration be over-compensated (the focal length of the rays near the edge *ceteris paribus* longer), the edge of the disc is radiating on pushing in the eye-piece, and sharply defined on drawing it out. Of errors in the construction there are two in centering which come next under our observation.

The optical axes of the two lenses may be displaced, though still parallel, in which case the image of the *Sun* on the glass ball will be red on one side; or the axes of the lenses may be inclined toward each other, in which case the light will be unequally distributed on the disc on drawing the eye-piece

in or out, one side being very light and sharply defined, the other ill-defined and dissolving the disc nearest the image appearing not unlike a comet with tail.

A large variety of errors of construction are the errors in the figure of the surfaces (deviation from a spherical surface); they are generally concentric, on account of the method of polishing, and cause a part of the light to focus in another place. This destroys the evenness of the distribution in the discs, so that on pushing the eye-piece in or out from the plane of the image, an intensely bright spot appears in some planes while others are too dark.

Errors of surface may cause the same results as errors of form (sphericity), though the disturbances are generally more irregular.

Irregularities in the discs occur when the lenses are bent out of shape in mounting or when there has been too great or too irregular pressure in polishing, or any surface, which on being removed causes a change of shape. From both of these sources the discs suffer changes like those occurring from regular or irregular astigmatism of the eye.

Of the errors of construction scratches or streaks in the polished surfaces have the least influence, and even when they are very marked they produce hardly any effect.

Of the flaws in the material, gritty places, bubbles, etc., do not cause much disturbance. They take up a little of the light, and when they are very large they cause (by reflection) a lustre on the image, because the light which they reflect does not unite to form the main image.

These errors generally are only disturbing when very bright objects are observed.

Waves in the glass on the other hand exert a strong disturbing influence, because comparatively large parts of the light which fall upon the objective from a point are wrongly refracted and focus elsewhere than in the plane of the image. The larger the area of these waves, the more do they injure the image, while those which are thread-like in form, though they are easily apparent, are not very injurious because they affect only a small portion of the light.

The waves are most easily seen by pointing a telescope at a bright object, unscrewing the eye-piece and placing the eye in the focus of the objective; its whole surface will then be evenly illuminated, and the waves are discernible by their differing intensity of light.

This exhausts those errors which affect that point in the image which falls on the axis, and we have yet to consider the errors which arise from the inequality of the real focal distances, either between the centre and the edge of the objective (distortion), or between two differently colored rays, (inequality in the size of the different-colored images).

If the "Haupt punkte" alone are different, the image in the axis will still be good.

But the real focal distances may be dissimilar when errors of sphericity and color are also present. In this case, however, the distinctness of the image has already been destroyed.

If any objective is free from errors of sphericity and distortion, and is pointed at a distant line, dark against a light back ground, and the eye is brought into such a position that it can distinctly see the image of the line formed by the objective, this image will remain straight on tipping the objective. The image bends, however, to one side or the other, according as the true focal distances of the edges and middle are unequal. In case the focal distance of the edge is longer, the sides of a square would be concave toward the outside, if the focal distance is longer at the axis, the square would be convex toward the outside.

With objectives consisting of two lenses only, it is difficult to bring out important errors in the size of images of different colors if there is not present at the same time a second error, either distortion or a color-error.

The effect of such errors is that large images are bordered by bands of that color which has the longest focal distance."

A catalogue of variable stars, by Mr. J. E. GORE, published in Vol. IV of the *Proceedings* of the Royal Irish Academy, contains about 190 stars with notes, and will be found useful to those prosecuting this interesting branch of astronomy. —*Nature.*

RECENT PECULIAR ATMOSPHERIC CONDITIONS.

BY J. R. HOOPER, BALTIMORE.

Having noticed during the last six months, an unusual amount of bad "seeing" and especially so in daytime, the cause became a subject of inquiry, and as a result, I beg leave to submit for record, the following notes which may also serve to call out other and more valuable observations.

At night, up to August, the power of the telescope to define has been very unsatisfactory, and in daytime there has been a constant and marked trouble in seeing even second magnitude stars. The unprecedented cloudiness of the first three months of the year, has greatly lessened the number of clear days usually enjoyed. When the clear skies came, the difficulty of doing such daytime work as I had formely done, was noticed, and still exists at this time of writing.

I therefore raise this query: Is there a change in the atmosphere, or is there in it a foreign material which is capable of modifying the visibility of other than the brightest objects?

Every observer is acquainted with the deceptive "apparent" blue skies, but as bearing on the above query, I append a few data from my own observations made at 8 A. M. and 4 P. M., from April to August of the present year, as follows:

The marked trouble in seeing stars as bright as the second magnitude; frequently not seeing *α Andromedæ* when near the zenith at 8 A. M.

A corresponding indistinctness in first magnitude stars

In following *Mercury* in 1883, I readily found him sixteen days after inferior conjunction, though in the *Sun's* rays, and I could see the crescent very neatly defined a week later.

In 1884, though searching carefully, it was thirty-one days after inferior conjunction before I could see the planet, and then it was five days after greatest elongation. At no time

has the disk been fairly defined, while last year the reverse was the rule.

In all observations during these months, the definition of details of every kind on the *Sun's* face has been superior to that of last year. Hence, the idea comes to mind that there may be some substance in the air which diffuses the *Sun's* light to an unusual degree, but does not affect the seeing at night, nor make bad definition for the *Sun's* surface. The stars may seem fainter because of the whiteness of the sky otherwise unnoticeable.

In January and February of this year, I sometimes noticed a peculiar pearly whiteness around the *Sun* before sunset, and outside of that a dingy reddish tint, the radius of the arc being from 20° to 30°. In March I began to see at midday, a complete halo of the same color, having a radius of about 20°. When the sky was very blue it was well defined, but on days when the whiteness was present it was not seen. In July I measured it on one occasion, and made the inner edge nine degrees from the *Sun* with a breadth of seven degrees.

I find in looking back through the notices of the red sunsets, that Mr. CAPRON at the January meeting of the Royal Astronomical Society, mentioned the existence of a circle of red tint about the *Sun* at midday. In April, several writers spoke of a suspected connection between the red sunsets and the bad definition of the telescope. In a letter to the *English Mechanic* for June 20, a Fellow of the Royal Society writes:

"As to the bad definition incident on the visibility of the after-glow, I should like to remark that for some time past, daylight definition of celestial objects has been worse than ever I remember it during my tolerably long observing experience.

Transit-taking in daylight, save with the large stars, has been quite impracticable, and over and over again I have looked in vain for *Mercury*. * * * Of course every one who is in the habit of using a telescope in the daytime, is familiar with the fact that on many seemingly cloudless days there is an otherwise invisible kind of haze which impairs or destroys definition; and that the best and brightest vis-

ion is obtained in the blue sky visible below large floating *Cumuli*. But this curious obscuration has been just apparent during the latter condition of the atmosphere as during the former."

In July, another writer speaks in the same way of the difficulty of seeing objects within 30° of the *Sun's* place, and mentions the dusky red halo as having been under his notice for some months. We notice also, that on page 79 of the SIDEREAL MESSENGER for August, in the Washington report of observations upon *Sirius* is the significant remark:

"This companion has been unusually faint during the present year."

We need add at present only one other interesting notice of these late atmospheric conditions taken from the *Scientific American*, (Aug. 16), as follows:

"Since the appearance of the brilliant sunsets, Messrs. THOLLON and PERROTIN have noticed that the sky at Nice seems to have lost much of its ordinary transparency. They have been accustomed, on every fair day, to examine the sky in the neighborhood of the *Sun*, placing themselves near the border of the shadow projected by one of the observatory buildings. When thus sheltered from the direct rays of the *Sun*, they have noticed in former years that the blue of the sky continued to the very borders of the solar disk. If they were so placed that the disk was almost a tangent to the border of the screen, but still invisible, no increase in the brilliancy of illumination indicated the place where the point of tangency would be found. This is now no longer the case. Since the month of November, even upon the brightest days, the *Sun* appears constantly surrounded by a circular fringe of dazzling white light, slightly tinged with red at its outer edge, and with blue on the inner edge. There is a sort of ill-defined corona, with an apparent radius of about fifteen degrees. It would be interesting to know whether this fact is general, and whether it can be considered as connected with the volcanic dust or other causes of the late brilliant twilights."

REV. T. E. ESPIN publishes in the *Transactions* of the Liverpool Astronomical Society a catalogue of the magnitudes of 50 stars in Auriga, Gemini and Leo Minor, which have been determined from photographs taken by means of the equatorial stellar camera of the Society's observatory.

THE U. S. NAVAL OBSERVATORY.

In the Washington *Post* of August 10, 1884, there is a long article upon the Naval observatory, from which the following extracts are made:

THE STAFF OF OFFICERS AND PROFESSORS.

In addition to Com. Franklin, who as already stated, is in charge of the observatory, the working staff of the observatory is as follows: Com. W. T. Sampson, Assistant to Superintendent; Lieuts. E. C. Pendleton, C. G. Bowman, John Garvin and J. C. Wilson; Ensigns W. H. Allen, Hiero Taylor and J. A. Hoogewerff; Professors Asaph Hall, William Harkness, J. R. Eastman, Edgar Frisby and Stimson J. Brown, scientific corps; A. N. Skinner, W. C. Winlock and H. M. Paul, aids or assistant astronomers; William M. Brown, Jr., R. S. Woodward, A. S. Flint, A. Hall, Jr., computers; Thomas Harrison, clerk.

In the institution, as on board ship, naval discipline is observed, although, of course, not with the same rigidity. The methods of the observatory, the manner in which the work is outlined, and its character, are so little known that the following recent general order will be novel and interesting:

GENERAL ORDER No. 2. The Board formed under the General Order of June 18, 1884, having met on the 1st of July and decided upon the plan of work to be pursued at the Naval observatory for the six months ending December 31, 1884, it is hereby directed that in accordance with that decision each officer and observer shall see to the due prosecution of the work with which he is specially charged. The several divisions of the work are as follows:

Division A—The Great Equatorial. 1. Observations of a selected list of double stars will be continued. These stars are such as have rapid orbital motions, or which present some other interesting peculiarity.

2. Conjunction of the inner satellites of *Saturn* during the next opposition of the planet will be observed. There will also be made a complete micrometrical measurement of the dimensions of the ring.

3. There will be made three drawings of *Saturn*; one before opposition; one at or near opposition and one after opposition.

4. The observations which have been begun for stellar parallax, and for the temperature co-efficient of the screw of the micrometer, will be finished.

Division B—The Transit Circle. 1. Observations of the *Sun* will be made whenever the necessary ephemeris stars can be observed and the required instrumental corrections determined.

2. The *Moon* will be observed through the whole lunation.

3. The major planets will be observed from fifteen to twenty times near opposition.

4. Each minor planet will be observed at least five times near opposition.

5. Observations of the list of miscellaneous stars will be finished as soon as practicable.

The officer in charge of this instrument will be furnished with corrections to the ephemerides of the minor planets on application to the officer in charge of the 9.6-inch equatorial.

Division C—The Transit Instrument. 1. Observations will be made as often as practicable for time, for the correction of the standard mean time clock; and computations will be made daily for such correction.

2. Observations for the right ascensions of *Sun*, *Moon*, and inner planets to be made as frequently as possible; observations of the major planets and the brighter of the minor planets to be made near opposition; those of the *Moon* through the whole lunation.

3. The observations made during 1883 will be prepared for publication; and the computations of those of 1884 continued.

The officer in charge of this instrument will be furnished with the list of stars observed on the mural circle. The right ascensions of these stars will be observed on the transit instrument and the observations furnished to the officer in charge of the mural circle.

The corrections to ephemerides of minor planets will be furnished by the officer in charge of the 9.6-inch equatorial.

Division D—The 9.6-Inch Equatorial 1. Observations of all the minor planets whose brightness at opposition is greater than their mean brightness, will constitute the principal part of the work with this instrument.

2. Observations of comets to determine position and physical peculiarities.

3. Occultation of the stars by the *Moon*

4. When arrangements shall have been made to photograph the *Sun*, to examine with the spectroscope any *Sun*-spots which show any decided peculiarities in the photographs.

The officer in charge of this instrument will furnish to the officers in charge of the transit circle and transit instrument,

on application, corrections to the ephemerides of the minor planets.

Division E—The Prime Vertical Instrument. Observations of *a Lyræ* will be continued during the month of July, and the reduction of all observations will be proceeded with as rapidly as practicable. As suggested by Lieut. Bowman, equations of condition for a few of the stars which have been most frequently observed will be formed in order that the result from their solution may furnish a satisfactory test of the value of the work already done.

Division F—The Mural Circle. Observations will be made of stars down to the seventh magnitude, south of 10° north declination, the positions of which have not been recently determined at some northern observatory. The observing list to be formed of all stars from Gould's Uranometria Argentina visible here, and not contained in Yarnall's catalogue, the transit-circle list of B. A. C. stars, or the recent catalogue of the Glasgow observatory.

The right ascension of the stars observed with the mural circle will be observed with the transit instrument, and the observations furnished to the officer in charge of the former.

It is further ordered that observations with each instrument shall be continued uninteruptedly, notwithstanding some of the observers may be absent.

Division G—Time, Including Chronometers. The officer charged with the duty of sending out time signals will continue to do so, according to the system already adopted, and will also continue, as heretofore, the rating and care of the chronometers.

The Library. The librarian will attend to the destribution of the observatory publications as they may be received from the public printer. He will attend also to the arrangement and perservation of the books now on hand and those hereafter received, and will prepare for the bindery such publications as require binding. The catalogue which has been in course of preparation during the last two years of the publications contained in the library, will be made ready for sending to the printer as soon as the appropriation is available.

Books and publications will be purchased, as heretofore, according to selections made from lists to be submitted annually by the staff of the observatory, and such additional books as may be needed from time to time, will also be purchased, should the appropriation be sufficient.

COM. S. R. FRANKLIN, Superintendent,
Naval Observatory, July 1, 1884.

Observations of Meteors made at Vevay, Ind., by CHAS. G. BŒRNER, *August 10th, 11th and 12th, 1884. Lat. 38° 46′, Long. 84° 59′ 20″. 5; above sea level 525 feet.*

Date.	Time.		Number.	Duration of Flight.	Magnitude.	RADIANT. PATH. COLOR. TRAIN, ETC.
	h	m		s		
Aug. 10th, p. m.	8	23	1	2	1	α Cygni, path, β Ophiuchi; white nebulous train.
		32	2	2	1	γ Urs. Maj., path, due northwest; train visible 3 seconds.
		37	3	2	1	β Urs. Maj., path, westward; nucleus intensely brilliant, movement slow, train visible 3 seconds.
		50	4	1	2	η Pegasi, path, δ Cephei; faint, flight rapid.
	9	01	5	1	2	β Cygni, path, γ Draconis; faint nebulous train.
		03	6	2	1	γ Andromedæ, path, α Aquilæ; bright train, visible 3 seconds.
		04	7	1	2	γ Andromedæ, path, α Aquilæ; faint short train.
		07	8	1	3	α Cassiopeæ, path, α Cephei; faint short train.
		08	9	2	1	β Pegasi, path, δ Cygni; bluish tint, short luminous trains.
		11	10	2	1	γ Cor. Bor., path, η Bootis; moderate brilliancy.
		11	11	1	2	δ Cassiopeæ, path, β Andromedæ; faint luminous train.
		12	12	2	1	γ Urs. Maj., path, α Lyræ; bright train, visible 4 seconds.
		14	13	1	3	β Cassiopeæ, path, δ Andromedæ; nucleus of feeble light.
		21	14	1	3	β Cephei, path, η Draconis; faint short train.
		27	15	1	3	β Andromedæ, path, γ Pegasi; flight rapid without train.
		40	16	2	2	δ Cephei, path, β Lyræ; train

11th, p. m.		27	15	1	3	β Andromedæ, path, γ Pegasi; flight rapid without train.
		40	16	2	2	δ Cephei, path, β Lyræ; train of moderate brilliancy.*
	8	46	17	2	1	γ Cassiopeæ, path, α Andromedæ; color bluish white.
		47	18	2	1	β Cassiopeæ, path. γ Draconis; faint nebulous train.
		48	19	1	2	δ Cephei, path, δ Herculis; without train.
	9	02	20	2	3	γ Cassiopeæ, path, η Pegasi; short nebulous train.
		05	21	1	2	ζ Pegasi, path, β Delphini.
		15	22	2	1	α Perseus, path, δ Cephei; bright short train, motion slow.
	8	03	23	2	1	α Lyræ, path, ε Bootis; bright luminous train.
12th, p. m.		16	24	3	1	α Lyræ, path, α Urs. Maj., brilliant train about 3° long, visible 4 seconds, motion of train slightly wavy.
		39	25	2	1	α Aquilæ, path, α Ophiuchi; faint short train.
		45	26	2	1	α Cor. Bor. path α Cygni. Up to 9:30 p. m. no meteor appeared and watching was discontinued.

Of the total number 26 of meteors observed, eighteen (18) were conformable to the radiant in Perseus, and eight (8) noncomformable; of the above number there are 13 of the 1st magnitude with average duration of flight of 2.1 seconds. 8 of the 2d magnitude with average duration of flight of 1.3 seconds; 5 of 3d magnitude with average duration of flight of 1.2 seconds.

The maximum number fell on the night of the 10th, with a gradual decrease on the 11th and 12th two (2) only were followed by long luminous trains; of the remainder the train were short or ill defined. It may reasonably be supposed that a greater number would have been visible on a dark, night, unfortunately as it was, the interposing moon prevented the opportunity.

*At this time the bright full moon had attained an altitude to obscure all stars below the 1st magnitude; watching discontinued.

PENDING PROBLEMS OF ASTRONOMY.*

With your permission, I propose this evening to consider some of the pending problems of astronomy,—those which seem to be most pressing, and most urgently require solution as a condition of advance; and those which appear in themselves most interesting, or likely to be fruitful, from a philosophic point of view.

Taking first those that lie nearest, we have the questions which relate to the dimensions and figure of the Earth, the uniformity of its diurnal rotation, and the constancy of its poles and axis.

I think the impression prevails, that we already know the Earth's dimensions with an accuracy even greater than that required by any *astronomical* demands. I certainly had that impression myself not long ago, and was a little startled on being told by the superintendent of our Nautical Almanac that the remaining uncertainty was still sufficient to produce serious embarrassment in the reduction and comparison of certain lunar observations. The length of the line joining, say, the Naval observatory at Washington, with the Royal observatory at the Cape of Good Hope, is doubtful; not to the extent of only a few hundred feet, as commonly supposed, but the uncertainty amounts to some thousands of feet, and may possibly be a mile or more, and probably not less than a ten-thousandth of the whole distance; and the *direction* of the line is uncertain in about the same degree. Of course, on those portions of either continent which have been directly connected with each other by geodetic triangulations, no corresponding uncertainty obtains; and as time goes on, and these surveys are extended, the form and dimensions of each continuous land-surface will become more and more perfectly determined. But at present we have no satisfactory means of obtaining the desired accuracy in the relative position of places separated by oceans, so they can-

*From an address to the American association for the advancement of science at Philadelphia, Sept. 5, 1884, by Prof C. A Young, at Princeton, retiring president of the association.—*Science.*

not be connected by chains of triangulation. Astronomical determinations of latitude and longitude do not meet the case; since, in the last analysis, they only give at any selected station the *direction of gravity* relative to the axis of the Earth, and some fixed meridian plane, and do not furnish any *linear* measurement of dimension.

Of course, if the surface of the Earth were an exact spheroid and if there were no irregular attractions due to mountains and valleys and the varying density of strata, the difficulty could be easily evaded; but, as the matter stands, it looks as if nothing short of a complete geodetic triangulation of the whole Earth would ever answer the purpose,—a triangulation covering Asia and Africa, as well as Europe, and brought into America by way of Siberia and Behring Strait.

It is indeed theoretically possible, and just conceivable, and the problem may some day be reversed, and that the geodesist may come to owe some of his most important data to the observers of the lunar motions. When the relative position of two or more remote observatories shall have been precisely determined by triangulation (for instance, Greenwich, Madras, and the Cape of Good Hope), and when, by improved methods and observations made at these fundamental stations, the *Moon's* position and motion relative to them shall have been determined with an accuracy much exceeding anything now attainable, then by similar observations, made simultaneously at any station in this hemisphere it will be theoretically possible to determine the position of this station, and so, by way of the *Moon*, to bridge the ocean, and ascertain how other stations are related to those which were taken as primary. I do not, of course, mean to imply, that in the *present state* of observational astronomy, any such procedure would lead to results of much value; but, before the Asiatic triangulation meets the American at Behring Strait, it is not unlikely that the accuracy of lunar observations will be greatly increased.

The present uncertainty as to the Earth's dimensions is not, however, a sensible embarrassment to astronomers, except in dealing with the *Moon*, especially in attempting

to employ observations made at remote and ocean-separated stations for the determination of her parallax.

As to the form of the Earth, it seems pretty evident that before long it will be wise to give up further attempts to determine exactly what spheroid or ellipsoid *most nearly corresponds* to the actual figure of the Earth; since every new continental survey will require a modification of the elements of this spheroid in order to take account of the new data. It will be better to assume some closely approximate spheroid *as a finality*; its elements to be forever retained unchanged, while the deviations of the actual surface from this ideal standard will be the subject of continued investigation and measurement.

A more important and anxious question of the modern astronomer is: Is the Earth's rotation uniform, and, if not, in what way and to what extent does it vary? The importance, of course, lies in the fact that this rotation furnishes our fundamental measure and unit of time.

Up to a comparatively recent date, there has not been a reason to suspect by human observation. It has long been preceived, of course, that any changes in the Earth's form or dimensions must alter the length of the day. This displacement of the surface or strata by earthquakes or by more gradual elevation and subsidence, the transportation of matter towards or from the equator by river or ocean currents, the accumulation or removal of ice in the polar regions or on mountain-tops,—any such causes must necessarily produce a real effect. So, also, must the friction of tides and trade-winds. But it has been supposed that these effects were so minute, and to such an extent mutually compensatory, as to be quite beyond the reach of observation; nor is it yet certain that they are not. All that can be said is, that it is now beginning to be *questionable* whether they are, or are not.

The reason for suspecting preceptible variation in the Earth's revolution, lies mainly in certain unexplained irregularities in the apparent motions of the *Moon*. She alone, of all the heavenly bodies, changes her place in the sky so

rapidly, that minute inaccuracies of a second or two in the time of observation would lead to sensible discrepancies in the observed position; an error of one second, in the time, corresponding to about half a second in her place,—a quantity minute, certainly, but perfectly observable. No other heavenly body has an apparent movement anywhere nearly as rapid, excepting only the inner satellite of *Mars*; and this body is so minute that its accurate observation is impracticable, except with the largest telescopes, and at the times when *Mars* is unusually near the Earth.

Now, of late, the motions of the *Moon* have been very carefully investigated, both theoretically and observationally; and, in spite of everything, there remain discrepancies which defy explanation. We are compelled to admit one of three things,—either the lunar theory is in some degree mathematically incomplete, and fails te represent accurately the gravitational action of the Earth and *Sun*, and other known heavenly bodies, upon her movements; or some unknown force other than the gravitational attractions of these bodies is operating in the case; or else, finally, the Earth's rotational motion is more or less irregular, and so affects the time reckoning, and confounds prediction.

If the last is really the case, it is in some sense a most discouraging fact, necessarily putting a limit to the accuracy of all prediction, unless some other unchanging and convenient measure of time shall be found to replace the "day" and "second."

The question at once presents itself: How can the constancy of the day be tested? The lunar motions furnish grounds of suspicion, but nothing more; since it is at least as likely that the mathematical theory is minutely incorrect or incomplete as that the day is sensibly variable.

Up to the present time, the most effective tests suggested are from the transits of *Mercury* and from the eclipses of *Jupiter's* satellites. On the whole, the result of Professor NEWCOMB'S elaborate and exhaustive investigation of all the observed transits, together with all the available eclipses and occultations of stars, tends rather to establish the sen-

sible constancy of the day, and to make it pretty certain (to use his own language) that "inequalities in the lunar motions, not accounted for by the theory of gravitation, really exist, and in such a way that the mean motion of the *Moon* between 1800 and 1875 was really less (*i. e.*, slower) than between 1720 and 1800." Until lately, the observations of *Jupiter's* satellites have not been made with sufficient accuracy to be of any use in settling so delicate a question; but at present the observation of their eclipses is being carried on at Cambridge, Mass., and elsewhere, by methods that promise a great increase of accuracy over anything preceding. Of course, no *speedy* solution of the problem is possible through such observations, and their rusult will not be so free from mathematical complications as desirable,—complications arising from the mutual action of the satellites, and the ellipsoidal form of the planet. On account of its freedom from all sensible disturbances, the remote and lonely satellite of *Neptune* may possibly some time contribute useful data to the problem.

We have not time, and it lies outside my present scope, to discuss whether, and, if so, how, it may be possible to find a unit of time (and length) which shall be independent of the Earth's conditions and dimensions (free from all *local considerations*), cosmical, and as applicable in the planetary system of the remotest star as in our own. At present we can postpone its consideration; but the time must unquestionably come, when the accuracy of scientific observation will be so far increased, that the irregularities of the Earth's rotation, produced by the causes alluded to a few minutes ago, will protrude, and become intolerable. Then a new unit of time will have to be found for scientific purposes, founded, perhaps, as has been already suggested by many physicists, upon the vibrations or motion of light, or upon some other physical action which pervades the universe.

Another problem of terrestrial astronomy relates to the constancy of the position of the Earth's axis in the globe. Just as displacements of matter upon the surface or in the interior of the Earth would produce changes in the time of

rotation, so also would they cause corresponding alternations in the position of the axis and in the places of the poles,—changes certainly very minute. The only question is, whether they are so minute as to defy detection. It is easy to see that any such displacements of the Earth's axis will be indicated by changes in the *latitudes* of our observatories. If, for instance, the pole were moved a hundred feet from its present position, towards the continent of Europe, the latitudes of European observatories would be increased about one second, while in Asia and America the effects would be trifling.

The only observational evidence of such movements of the pole, which thus far amounts to any thing, is found in the results obtained by NYREN in reducing the determinations of the latitude of *Pulkowa*, made with the great vertical circle, during the last twenty-five years. They seem to show a slow, steady diminution of the latitude of this observatory, amounting to about a second in a century, as if the north pole were drifting away, and increasing its distance from *Pulkowa* at the rate of about one foot a year.

The Greenwich and Paris observations do not show any such results; but they are not conclusive, on account of the difference of longitude, to say nothing of their inferior precision. The question is certainly a doubtful one; but it is considered of so much importance, that, at the meeting of the International Geodetic association in Rome last year, a resolution was adopted recommending observations specially designed to settle it. The plan of Sig. FERGOLA, who introduced the resolution, is to select pairs of stations, having nearly the same latitude, but differing widely in longitude, and to determine the *difference* of their latitudes by observations of the same set of stars, observed with similar instruments, in the same manner, and reduced by the same methods and *formulæ*. So far as possible, the same observers are to be retained through a series of years, and are frequently to exchange stations when practicable, as to eliminate personal equations. The main difficulty of the problem lies, of course, in the minuteness of the effect to

be detected; and the only hope of success lies in the most scrpulous care and precision in all the operations involved.

Other problems, relating to the rigidity of the Earth and its internal constitution and temperature, have, indeed, astronomical bearings, and may be reached to some extent by astronomical methods and considerations; but they lie on the border of our science, and time forbids anything more than their mere mention here.

If we consider, next, the problems set us by the *Moon*, we find them numerous, important, and difficult. A portion of them are purely mathematical, relating to her orbital motion; while others are physical, and have to do with her surface, atmosphere, heat, etc.

As has been already intimated, the lunar theory is not in a satisfactory state. I do not mean, of course, that the *Moon's* deviations from the predicted path are gross and palpable, —such, for instance, as could be preceived by the unaided eye (this I say for the benefit of those who otherwise might not understand how small a matter sets astronomers to grumbling); but they are large enough to be easily observable, and even obtrusive, amounting to several seconds of arc, or miles of space. As we have seen, the attempt to account for them by the irregularity of the Earth's rotation has apparently failed; and we are driven to the conclusion, either that other forces than gravitation are operative upon the lunar motions, or else (what is far more probable, considering the past history of theoretical astronomy) that the mathematical theory is somewhere at fault.

To look at the matter a little from the outside, it seems as if that which is most needed just now, in order to secure the advance of science in many directions, is a new, more comprehensive, and more manageable solution of the fundamental equations of motion under attraction. Far be it from me to cry out against those mathematicians who delight themselves in transcendental and n-dimensional space, and a revel in the theory of numbers,—we all know how unexpectedly discoveries and new ideas belonging to one field of science find use and application in widely different regions,

—but I own, I feel much more interest in the study of the theory of functions and differential equations, and expect more aid for astronomy from it.

The problem of any number of bodies, moving under their mutual attraction, according to the Newtonian laws, stands, from a physical point of view, on precisely the same footing as that of *two* bodies. Given the masses, and the positions and velocities corresponding to any moment of time, then the whole configuration of the system of all time, past and future (abstracting outside forces, of course), is absolutely determinate, and amenable to calculation. But while in the case of *two* bodies, the calculation is easy and feasible, by methods known for two hundred years, our analysis has not yet mastered the general problem for more than two. In special instances, by computations, tedious, indirect, and approximate, we can, indeed, carry our predictions forward over long periods, or indicate past conditions with any required degree of accuracy; but a general and universally practicable solution is yet wanting. The difficulties in the way are purely mathematical: a step needs to be taken, corresponding in importance to the introduction of the circular functions, into trigonometry, the invention of logarithms, or the discovery of the calculus. The problem confronts the astronomer on a hundred different roads; and, until it is overcome, progress in these directions must be slow and painful. One could not truly say, perhaps, that the lunar theory must, in the mean while, remain quite at a standstill: labor expended in the old ways, upon the extension and development of existing methods, may not be fruitless, and may, perhaps, after a while, effect the reconcilement of prediction and observation far beyond the present limits of accuracy. But if we only had the mathematical powers we long for, then progress would be as by wings: we should fly, where now we crawl.

As to the physical problems presented by the *Moon*, the questions relating to the light and heat—the radiant energy it sends us, and to its temperature, seem to be the most attractive at present, especially for the reason that the results

of the most recent investigators seem partially to contradict those obtained by their predecessors some years ago. It now looks as if we should have to admit that nearly all we receive from the *Moon* is simply *reflected* Sun-light and Sun-heat, and that the temperature of the lunar surface nowhere rises as high as the freezing-point of water, or even of *Mercury*. At the same time, some astronomers of reputation are not disposed to admit such an upsetting of long-received ideas; and it is quite certain, that in the course of the next few years, the subject will be carefully and variously investigated.

Closely connected with this is the problem of a lunar atmosphere—if, indeed, she has any.

[*To be continued.*]

Note on the Comparison of the Coast Survey Catalogue of Latitude Stars, with the Fundamental Catalogues of Safford, Boss and Auwers.

BY JOHN TATLOCK, JR.

Having had occasion to examine the declination of certain stars used for the determination of a latitude, whose places were originally taken from the Catalogue of Latitude Stars published as Appendix No. 7, to the Coast Survey Report of 1876, I have been led to compare the declination of these stars, as given in that paper, with the places of the same stars as given in the so-called fundamental catalogues of Safford, Boss and Auwers. As the results of this comparison may not be uninteresting to some of the readers of the MESSENGER, I have given in the following table the discrepancies between the places, as given in the Coast Survey Catalogue, and those given in the other authorities. Of course it will be understood that this comparison is not considered as, in any sense, a comparison of the Coast Survey *Catalogue*, but simply pertains to the places of the stars here given.

In the following table $\Delta\delta$ denotes the *correction* to the C. S. Catalogue place, as given by the several authorities, and

$\Delta\mu'$ the *correction* to the proper motion as given in that catalogue to reduce it to the value given in the standard catalogues.

The corrections hold good for 1880.0.

B. A. C. No.	Name of Star.	$\Delta\delta$			$\Delta\mu'$		
		Safford.	Boss.	Auwers.	Safford.	Boss.	Auwers.
		"	"	"	"	"	"
6857	Cygni	−0.55					
6876	Cygni	−0.19					
6912	17 Vulpeculæ	−0.47			−0 005		
6932	66 Draconis	+0.03			0.000		
6970	68 Draconis	+0.25	+0.99		−0.01	+0.018	
6968	22 Vulpeculæ	−1.26			−0.038		
6986	Cygni	−0.10					
7067	41 Cygni	+0.16			−0.01		
7086	Cygni	+0.18					
7158	Cygni	+0.48					
7171	a Cygni	+0.33	−0.16	−0.08	+0.003	−0.008	+0.003
7204	ε Cygni	+0.20	−0.46	−0.22	+0.007	−0.014	+0.015
7301	f Cygni	−0.36			−0.008		
7320	Cygni	+0.62	+0.13		+0.05	+0.013	
7336	61 Cygni	+0.08	−0.27	−0.34	+0.011	+0.008	+0.010
7345	f^2 Cygni	−1.12	−1.40		−0.02	−0.025	
7368	ζ Cygni	−0.22	−0.39	−0.45	0.000	+0.003	+0.004
7401	D M 55° 2549	+2.26			+0.11		
7411	Cygni	+0.84					
7453	69 Cygni	−0.67	−0.58		−0.027	−0.035	
7503	ρ Cygni	−1.30			−0.046		
7521	74 Cygni	−0.37	−0.25	−0.91	0.000	−0.010	−0.001
7544	75 Cygni	−0.22			−0.023		
7571	$\varkappa$ Pegasi	−0.34	−0.57	−0.46	−0.020	−0.041	−0.017
7595	γ Cephei	+0.48	−0.09		+0.025	−0.082	
7607	14 Pegasi	−0.41			−0.013		
7631	Cygni	+0.54			+0.06		
7676	Cygni	+0.24					
7721	π Pegasi	−1.98		−1.61	−0.036		−0.031
7749	ζ Cephei	+0.60	+0.68	+0.68	+0.002	+0.014	+0.004
7798	32 Pegasi	−0.84			−0.01		
7850	6 Lacertæ	−0.54			−0.01		
7914	o Pegasi	−0.88			−0.022		
7932	13 Lacertæ	−0.89		−1.26	−0.006		−0.008
7948	Lacertæ	−0.60					
7972	15 Lacertæ	−0.11			+0.01		
7984	Lacertæ	−0.47			0.000		
8058	4 Andromedæ	−0.26			+0.045		
8125	11 Andromedæ	+1.11			+0.007		
8136	12 Andromedæ	−1.26			−0.026		
8229	2 Andromedæ	−0.49	−0.32	−0.71	−0.026	−0.025	−0.032
8256	78 Pegasi	−1.20			−0.048		
8310	ρ Cassiopeæ	−1.79		−1.83	+0.001		−0.002
8324	4 Pegasi	−1.16	−1.21		−0.023	−0.034	
8344	Cassiopeæ	−0.04	−0.22		−0.004	−0.010	

EDITORIAL NOTES.

The thirty-third meeting of the American Association for the Advancement of Science, which convened this year, in Philadelphia, Sept. 4–11, was in numbers and character, one of the great meetings in the history of the association. It was but natural to expect such a result in view of the fact that more than one-half of the entire membership of the association resides in New England and east of the Alleghenies, and also because Philadelphia was known to possess and generously to offer many other advantages for the meeting of such an association that could be scarcely equalled in any other locality in the United States. The membership of the association preceding the Phil adelphia meeting was 2011. Attendance at Philadelphia was 1249, and the number of new members elected during the meeting was 491.

At the Philadelphia meeting there were sixty persons representing various foreign societies, which was an interesting feature, the large number being due to the fact that the meeting of the British association had taken place only a few days before at Montreal, Canada. Some of the more prominent persons who were present as delegates from the foreign societies were: Professor R. S. Ball, the Royal Astronomer of Ireland; Sir. Wm. Thompson, W. H. Preece, W. T. Blanford, Royal Society; E. B. Taylor, Author of the Early History of Mankind; Professor Adams, the Cambridge astronomer; Captain Pym, of the Royal Navy; Professors George Forbes and James Mactear, of Glasgow; Professor Struther and Dr. Robert Beveridge, of Aberdeen. There were also delegates from the Belfast Natural History Society, Geological Survey of India, Asiatic Society of Bengal, Asiatic Society of Japan, Natural History of Glasgow, Manchester Philosophical Society, Zoological Society of London, Botanical Society of Edinburgh, Royal Irish Academy, University of Japan, and many others quite as important to science as those already named. This indicates some of the interest that educated gentlemen of the foreign societies take in the character and progress of similar work on this side of the Atlantic. The chief address of the more elaborate ones at the Philadelphia meeting of the A. A. A. S., was delivered by the retiring President of the Association, Professor Charles A. Young, Princeton College, N. J., on the theme *Pending Problems in Astronomy*. Those who are acquainted with Professor Young's style know that it is always clear and apt; that he has remarkable insight in discussing theories, in balancing probabilities, and in stating the unsolved problems of astronomy as they lie in his own mind. The address successfully presents the knotty questions of astronomy in their latest phases, so that others

less familiar with the intricate ways of the scholars, may yet get a definite knowledge of what is known to the science, and distinguish it from that which is not known. It is to be hoped that no one interested in astronomy will fail to read the address, because it is a complete unfolding of all its title implies that could well be given in a single paper. No abstract would do it justice; so we shall continue it in parts in following numbers.

DISCOVERY OF A SUSPECTED COMET.

On the evening of September 9th, about nine o'clock, while comet sweeping, I picked up a nebulous object in, approximately, right ascension $13^h\ 5^m$; declination north 57°. It was faintish, but easily seen with the sky illuminated by the approaching moonlight. After the *Moon* rose, it was not visible in the 9-inch reflector, so that further observations that night was impossible. The next evening it rained. On the following evening, however, the sky was very clear, and the seeing far better than on the 9th, but the suspected object was missing, and a very careful search for several evenings following, failed to rediscover it. On the morning of the 12th, I telegraphed to Dr. SWIFT, and through him, Harvard College observatory, to assist in the search, but without success up to this writing.

Red House Observatory,
September, 19th, 1884.

WILLIAM R. BROOKS.

DRAWING OF SATURN.

February 11th, 1884.

Mr. Henry Pratt, F. R. A. S., has recently printed in the Monthly Notices, a beautiful Woodbury type of a drawing of *Saturn* by himself.

As a scheme of the planet and rings, it is very satisfactory as it shows nearly every feature whose existence is undoubted, and none upon which much doubt is cast.

The refraction of the dusky ring in front of the planet by the planet's own atmosphere does not appear to the writer to be quite successfully portrayed, though it clearly is an attempt to depict the veritable phenomenon.

Whether in the printing of the especial copy of the Woodbury type, accessible to the writer, or by real design it is impossible to say, but the brightness of the brightest part of the whole system (ring B), is not uniform. In the writer's experience, the brightest part of ring B is equally bright all round the planet, east as well as west. In the picture it is noticeably not so.

A crucial test of the pictorial accuracy of a drawing of *Saturn* is to view it up-side down, and this picture, in spite of its real excellence, will not stand this test.

The ball appears to be unsymmetric in the rings. This lack of symmetry appears less strikingly in the proper view of the picture. The

best view of the drawing is to be had by making the preceding ansa the top of the picture, and by allowing the light to be transmitted through the picture not reflected from it. Seen in this way it is of remarkable beauty. E. S. H.

The observers at Davidson observatory, San Francisco, California, under date Sept. 3, 1884, kindly favor the MESSENGER with the following notes and observations:

"The attention which has been called to the not instantaneous disappearance of the star B. A. C. 1992, the companion of *Beta Capricorni*, at its occultation last November, prompts me to send you the following table from my records to note another star that was not absolutely instantaneous.

"At the same time I made mention that on the 12th of September, 1883, I observed the occultations of *Beta Capricorni* and its companion, and I find no note made upon the appearance of the companion, to indicate any decrease of its light at the time of occultation.

"Last night I lost the occultations of *Beta Capricorni* and its companion, on account of fog which cleared away too late."

OCCULTATIONS.

Occultations of stars by the *Moon*, observed at the Davidson observatory, April 1st, 1884.

Disappearance of star.	Observer.	Teles'pe. Apert.	Teles'pe. Power	Observed Local Time. Mean.	Observed Local Time. Sidereal.	Remarks.
		In.		h m s	h m s	
Arg. +18°:1178	D.	6.4	120	8 28 26.44	7 44 49.84	[instantaneous. Not absolutely
7.9 mag.	H.	3.0	105	8 28 26.43	7 44 49.83	Good.
+18°:1179	D.			8 29 49.84	7 46 13.01	—— [doubtful.
8.5 mag.	H.			8 29 51.36	7 46 14.53	too faint, very
+17°:1214	D.			9 09 05 19	8 25 21.93	——
6.5 mag.	H.			9 09 05.13	8 25 21.87	Good. Ob'rs using dif. chronometers.

Prof. GEORGE DAVIDSON has published a Field Catalogue of 1278 Time and Circumpolar stars for 1885.0 The preface refers to the previous editions of the list, which was "an out-growth of the necessities of those parties of the U. S. Coast and Geodetic Survey, which were engaged in Geographical Reconnaissance, Telegraphic Longitude, Latitude and Azimuth work, and special investigations demanding the determination of exact local time."

The present list of 1278 stars is in continuation of the earlier ones. It contains 12 columns. Col. 1 and col. 10 give the current numbers;

Col. 2 gives the star's name; col. 3, its magnitude; col. 4, the R. A. to 0ˢ.1; col. 5, its annual variation to 0ˢ.001; col. 6, dec. to 1″; col. 7, the annual variation to 0″.01; col. 8, the sec. dec. to 0.01; col. 9, the authorities for the star's place (28 in number, of which all but 4 are in the English language); col. 11 notes on color, duplicity, etc. etc., and col. 12 is left blank for MS. notes—settings?

It would seem that the present list of the *Berliner Jahrbuch* (650 stars), should be large enough for all purposes. It has the further advantage of being, at least, approximately homogeneous. The present list contains, however, nearly twice as many stars, and may present advantages in rapid and hurried work. For the more elaborate operations of the survey, it would appear to be less important to provide a great number of stars, than to provide stars whose positions have been carefully reduced to one homogeneous system.

The narrow thin white cloud extending from a point about 30° above the horizon in the west, to 20° beyond the zenith in the east, seen by Philadelphia observers in the evening of July 30th, was also noticed by Professor SWIFT of Warner observatory. Speaking of the description of it given by a correspondent last month, he says the description was almost exactly as it appeared to him. He further adds: "I was greatly interested in the object at the time, and have reflected on it much since, but have not been able to find a satisfactory explanation as to what it was. I thought it a long narrow cloud at first, but its exceedingly slow motion soon convinced me that it was not a cloud. An auroral beam next suggested itself, of which I have seen several, but unlike them, it was not at right angles to the magnetic meridian as were the others. It was a conspicuous object visible for about forty-five minutes, and then disappearing in the eastern horizon."

The same phenomenon was seen at Carleton College observatory.

DESCRIPTION OF A METEOR.

About 9 o'clock on the evening of August 19th, being at North Wales, Pa., (22 miles northwest of Philadelphia), my attention was called by a companion to a bright meteor, which was visible for 3 or 4 seconds, and which left a luminous train, lasting ten seconds or longer. I saw the meteor in time to notice the greater portion of its flight. It first appeared, as my companion pointed out, near *Ursæ Majoris*, and passing between "the pointers" in that constellation, and a little below *Gamma*, rather less than 1°, estimating from memory, it vanished when about south of *Epsilon Ursæ Majoris*, or nearly in 13ʰ right ascension.

The train seemed to loose its brightness a little sooner than the meteor, so that when the latter disappeared, which it did quite suddenly, the train was but a feeble line of light for the first 4 or 5 degrees, then where it was more brilliant, it slowly broadened out to a degree

or more in width, by the dispersion of the luminous matter, the whole extending about 25 degrees in length, and without the faint portion next to the meteor, presenting quite perfectly the form of a very elongated ellipse.

The meteor presented no percetible disc; but was five or six times brighter than *Venus* at her greatest brilliancy. It was undoubtedly one of the *Persids*, though considerably out of the beaten track. Another faint meteor apparently from the same source, was seen a few minutes later.

GEO. P. MERRIMAN.

New Brunswick, N. J.
Aug. 25th, 1884.

ELEMENTS OF COMET (*b*), 1884, BARNARD.

T=1884, Aug. 17. 7202, Greenwich, M. T.

π=303° 4′ 58″
Ω=357° 5′ 22″
ω=305° 59′ 36″
i= 6° 52′ 14″
log q=0.1407591
$d\lambda$=−11″.4.
$d\beta$=+76″.9

Computed from observations at Nashville, July 16 and 22, and at Cambridge, July 28.

GUSTAVE RAVENE.

Washington, D. C.,
Sept. 18, 1884.

The attention of observers is again called to the occultation of *Beta Capricorni* and its companion B. A. C. 1992, by the *Moon*, which takes place October 26th, $8^h\ 26^m.8$, Washington mean time. Three good observers claim that the companion is double. One predicted it several months ago from gradual disappearance when occulted by the *Moon*, the others have seen it double in a large telescope, and obtained the following measures, which were communicated directly to the MESSENGER:—Position angle 108°.6, Distance 0″.86. From recent private correspondence, it appears that some of the best observers in the country are not yet fully satisfied, and so we ask very general attention to the coming occultation, and indulge the hope that our readers may soon have the benefit of many observations.

Professor JOHN HEYWOOD of Otterbein College, Westerville, O., in a recent private letter, said that he had observed the *Moon* on the morning of September 16th, from $3^h\ 30^m$ to 4^h A. M., and found an unusually bright glow covering nearly uniformly the dark part of the *Moon's* disc. He thinks the phenomenon electric for two reasons: It was too bright for Earth-shine, and it obscured the features of the *Moon's* surface. This latter fact is puzzling and unsatisfactory. Professor HEYWOOD will give further attention to these interesting lunar phenomena, as he finds favorable opportunity for observation.

COMET BARNARD, 1884.

We received the following note from Mr. BARNARD too late for the September number of the MESSENGER:

"The comet reached its greatest southern declination July 28 or 29. Up to the last observations before the August *Moon* interfered, it had a tiny nucleus of about the eleventh magnitude. Since the *Moon* withdrew, it has not been possible to detect any evidence of a nucleus, although it is now very gradually a little brighter in the middle. On the 10th of August it was visible in the 1¾-inch finder. It has been observed on every favorable opportunity with the ring micrometer on the 6-inch equatorial. August 2nd it was seen in bright moonlight, but was exceedingly faint. August 6th I could barely see it in full moonlight. On the 11th it passed almost centrally over a 11th magnitude star which was considerably dimmed by the cometary light. Some twenty positions of this comet have been obtained here, every observation possible being secured."

The star near the comet July 18th was Lacaille 6637 of 7th magnitude. The light of the comet then was less than Lacaille 6607, which was the star referred to in the August MESSENGER, page 188.

SHORT FOCUS TELESCOPE.

Some time ago Professor HENRY HARRISON, of Jersey City, ordered of JOHN BYRNE, of New York City, a short focus telescope, and after testing it until he is satisfied, he claims that it is all that can be desired. He says: "The first object I viewad with the telescope was the planet *Saturn*, and the image surpassed anything I have heretofore seen; it was as sharp as if it had been cut out of a card board, and the rings and their divisions as well as the bands on the planet were clearly and well defined. *Saturn* was then in the zenith early in the evening, and five of its satellites were plainly visible. This planet was seen as well with a 0.2 eye-piece and an amplifier (giving a power of 380, its aperture being 4.25 inches and its focal length 39 inches), as I have seen it with Mr. RUTHERFORD'S 12.5-inch refractor. The planet *Jupiter* gave still better results; its satellites appeared perfectly round and their shadows on the planet's disc were sharp and well defined. The light properties of this instrument are excellent. The so-called spurious disc of a first magnitude star, viewed with the highest power is exceedingly small, and the performance of the severest tests is easily accomplished; e. g. *Iota Cassiopeæ*, 36. *Andromedæ*, *Sigma of Corona Borealis* with Smyth's 11 magnitude following,—*Delta Cygni*, *Lambda Ophiuchi*, etc.

This telescope does admirable service as a comet seeker, for a two-inch eye-piece gives a power of 20 and a field of about two degrees which exhibits the two beautiful clusters of *Perseus* (512 and 521) at once. There is also the further advantage of handling it easily, as

it does not require a large dome, a circumstance of importance to amateurs. I have possessed telescopes of normal length, but I have learned to prefer the 'Dumpy.'"

COMET WOLF, (1884).

Under date of Sept. 23, the following elements and ephemeris of the newly discovered comet, known as comet Wolf, were communicated by telegraph from Harvard College observatory as follows:

Two positions of this comet have been obtained at Harvard College observatory:

	d.	h.	m.	s.		App. α h.	m.	s.	App. δ °	′	″
Sept.	21	9	51	59	Cambridge, M. T.	21	15	52.88	21	52	37.8
"	22	7	50	46	Cambridge, M. T.	21	16	19.22	21	28	17.6

From these observations, together with the announcement of discovery position, given in Circular No. 51, the following orbit has been computed by Messrs. CHANDLER and WENDELL.

ELEMENTS.

T=1884, November, 25.03

π = 20 30
Ω = 199 31 } 1884.0
i = 31 22

log q=0.2202.

(C—O)
$\Delta\lambda \cos\beta$ = +0′.1
$\Delta\beta$ = 0′.0

EPHEMERIS.

Gr. M. T.		App. R. A. h.	m.	s.	App. Decl. °	′	Log. r.	Log. Δ.
Sept.	24.5	21	17	23	+20	35	0.2669	0.0033
	28.5		20	1	18	41	.2617	9.9980
Oct.	2.5		23	20	16	43	.2566	9.9940
	6.5		27	21	14	41	.2518	9.9913
	10.5		31	58	12	38	.2473	9.9903
	14.5		37	24	+10	31	.2430	9.9903

Light, September 17, unity. From September 24.5, to October 14.5, the computations show an increase of light from 1.11 to 1.32.

This comet was discovered by Dr. WOLF, of Zurich, September 17, 1884. It has a well-defined nucleus, and a faint short tail directed away from the *Sun*.

NEW NEBULA.

August 17th, Mr. E. E. BARNARD, of Nashville, Tenn., discovered an exceedingly faint nebula. It lies in low power field, with the small bright planetary nebula No. 4510 of the General Catalogue, and is south of that object.

Its position is, R. A. $19^h\ 38^m\ 25^s$
Decl. $-15°\ 2'\ 50''$ } 1884.0

This is the mean of two pointings with the 6-inch equatorial.

Quite a bright aurora was visible on the evening of the 13th inst. First noticed at $10^h\ 20^m$, at that time arch was about 10° above the horizon and nearly 4° in width. Very shortly, an appearance was presented resembling puffs of luminous smoke all along the arch, and at 10^h

30^m streamers began to shoot up towards the zenith, attaining an altitude of 20° or more. During the latter part of this time, the arch had risen somewhat, about $10^h\ 40^m$, witnessing the last of the streamers. Five minutes later the coronal appearance only was seen nearly reaching to *Alpha Ursæ Majoris*. Nothing more noted after $10^h\ 45^m$.

Hartford, Sept. 13th, 1884. W. C. P.

The following papers pertaining to Astronomy were read at the Philadelphia meeting of the A. A. A. S.:—

1. Results of Observations and Experiments with an "Almucantar" of four inches aperture at the Harvard College observatory, by S. C. Chandler, Jr.

2. On the Colors of Variable Stars, by S. C. Chandler, Jr.

3. Colors of the Stars. E. C. Pickering.

4. Temporary Stars. Daniel Kirkwood.

5. On the magnitude of the errors which may be introduced in the reduction of an observed system of stellar co-ordinates to an assumed normal system by graphic methods. Wm. A. Rogers.

6. Systematic Errors in Stellar Magnitudes. E. C. Pickering.

7. The Average Asteroid Orbit Ring and the Asteroid Ring. M. W. Harrington.

8. Micrometric Observations of *Jupiter's* third Satellite. David P. Todd.

9. On the Course of the Corrections to the Heliocentric Longitudes of Newcomb's tables of *Uranus* and *Neptune*. David P. Todd.

10. The Lunar Aurora. John Heywood.

11. Description of the Leander McCormick observatory of the University of Va. Ormond Stone.

12. On the Visibility of faint Objects under red Illumination. G. W. Hough.

13. The Nebulæ. Lewis Swift.

14. On the Constitution of the Earth and Planets. H. Hennessy.

15. Late Researches on the Solar Surface, with special reference to evanescent spots. S. I. Perry.

16. Harmonic Motion in Stellar Systems. P. E. Chase.

17. On the general expression for the value of the obliquity of the ecliptic at any given time, taking into account terms of the second order. J. C. Adams.

18. Note on Newton's Theory of Atmospheric Refraction, and on his method on finding the motion of the *Moon's* apogee. J. C. Adams.

All of these papers that can be secured, will be presented in the MESSENGER as early as practicable.

A new Minor Planet (239), was discovered by BORRELLY, at the observatory in Paris, August 27, $12^h\ 6^m.6$. Marseilles mean time. Its magnitude is 12. September 13, the discovery of another Minor Planet was reported by telegraph from Europe. It was found by Dr. LUTHER,

Sept. 12.379. Greenwich mean time. Its position was: R. A. $0^h\ 12^m\ 4^s$; Decl. $+10°\ 37'$. Eleventh magnitude. If new, its number is (240).

We expected this month to present an illustration, and a detailed description of the great dome of the Leander McCormick observatory of the University of Virginia, built by Messrs. WARNER & SWASEY, of Cleveland, Ohio. As the drawings have not yet reached us, it must be deferred.

The new Meridian Circle for Carleton College observatory, by the REPSOLDS of Hamburg, Germany, is daily expected. Drawings for the piers and transit-room were received some weeks ago.

The DePauw University, of Greencastle, Indiana, has just ordered a 9.5-inch equatorial, and a 17-foot iron Dome from Messrs. WARNER & SWAZEY, of Cleveland, Ohio.

Erratum. MESSENGER No. 26, page 184, line 23 from the top, for 3°.9, read 3.'9.

Subscriptions and orders not previously acknowledged:—Chas. G. Boerner, Vevay, Indiana; Frank Drummond, Lamoni, Ia.; George H. Peters, care of Western Insurance Company, Chicago, Ill.; Wm. H. Barton, Cambridge, Maryland; Professor John P. D. John, De Pauw University, Greencastle, Indiana; M. Payet, Director of the Observatory, Bordeaux, France, (Volumes II. and III.); Alfred Bicknell, 82 Water St. Boston; Mrs. E. J. Dole, Melrose, Mass.; Abraham Cooper, Zanesville, Ohio; A. H. Tomlinson, Locust Valley, Queens County, N. Y.

BOOK NOTICE.

Elements of Analytic Geometry: by Simon Newcomb: pp. 356. Henry Holt & Co.

This work is an excellent text-book; it is written with simplicity and clearness, and contains the subjects usually studied in a college course, excepting Higher Plane Curves. Eighty pages are devoted to Geometry of Three Dimensions, treating of the Straight Line, the Plane and Quadric Surfaces. The properties of Quadrics are deduced from the general equation, slight attention being paid to the ordinary method of obtaining the equations of surfaces of revolution from those of their generating curves. The number of exercises is more than sufficient for the wants of the ordinary student, and some of them will tax his best endeavors. Realizing the fact that there are always some students who delight in mathematical study, Prof. NEWCOMB has introduced some additional matter. In the body of the work are a few pages on the Synthetic Geometry of the Circle, and the last fifty pages of the book give an introduction to Modern Geometry. Teachers who devote a term to Analytic Geometry will do well to examine this work thoroughly. H. A. H.

XUM

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CALENDAR.

Fall Term began Wednesday, September 10, 1884.
Term Examinations December 22 and 23, 1884.
Winter Term begins Wednesday, Jan. 7, 1885; ends March 19, 1885.
Term Examinations March 18 and 19, 1885.
Spring Term begins Wednesday, April 1, and ends June 18, 1885.
Examinations to enter College, June 12 and 13, and Sept. 8, 1885.
Term Examinations, June 16 and 17, 1885.
Anniversary Exercises, June 15–18, 1885.
Exhibition at the Art Room of work of Pupils in Drawing and Painting, June 15–18, 1885.
Wednesday, September 9, 1885, Fall Term begins.
For further information address

JAS. W. STRONG, PRES., Northfield, Minn.

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